

RELATION BETWEEN FILTERING RATE, TEMPERATURE AND BODY SIZE IN *DAPHNIA SIMILIS* CLAUS (CRUSTACEA: CLADOCERA)¹

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Chi-Hsiang Lei, Li-Yung Hsieh and Chao-Kuan Chen (1991) Relation between filtering rate, temperature and body size in *Daphnia similis* Claus (Crustacea: Cladocera). Bull. Inst. Zool., Academia Sinica 30(1): 19-29. The filtering rates of unacclimated and acclimated female *Daphnia similis* Claus of various sizes were measured in algal suspension (*Chlorella* sp.) of 2×10^5 cells/ml at 15°C, 20°C, 25°C and 30°C, and relationships between filtering rate, body size and temperature were examined. Within the range of tested temperatures, the filtering rate (F , ml/animal/hr) increased allometrically with the increase of dry body weight (W , μ g). The filtering rate was proportional to the power 0.406-0.593 of the dry body weight. The exponent b 's in the relation, $\log F = \log a + b \log W$ were independent of temperature and state of temperature acclimation. The weight-specific filtering rate decreased with the increase of dry body weight. The filtering rates of acclimated animals appeared to be independent of temperature, whereas those of unacclimated animals showed some effects of temperature.

Key words: Temperature, Body size and Filtering rate of *Daphnia*.

Grazing (feeding) is the main biological process by which zooplankton obtain food from the external environment to provide the energy and material necessary for their maintenance (metabolism), growth and reproduction. It is also one of the key processes by which zooplankton interact with other components in the plankton communities. The rate at which zooplankton consume food is of basic importance since it affects not only the material income of the consumer (zooplankton) and sets an upper limit to its productivity, but also affects

the abundance and productivity of the prey (bacteria and phytoplankton). Therefore, the grazing rate of zooplankton and the effects of various factors on this rate have received considerable attention. The filtering rate of planktonic, filter-feeding crustaceans are known to be affected by various intrinsic (*e.g.* body size, stage of life cycle, sex and physiological state) and extrinsic (*e.g.* temperature, light, food quality and concentration, dissolved oxygen concentration and pH) factors (see reviews by Conover, 1978; Grahame, 1983; Marshall, 1973; Peters, 1984; Rigler, 1971). Although body size

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and temperature are two important factors affecting the filtering rate of planktonic, filter-feeding crustaceans, the relationships between filtering rate, body size and temperature in many species are still not known.

The filtering rate is a cube or near cube function of body length for *Daphnia rosea* (Burns and Rigler, 1967; DeMott, 1982), *D. middendorffiana* (Chisholm *et al.*, 1975), *D. pulex* (Buikema, 1973; Kring and O'Brien, 1976), *D. magna*, *D. schødleri* and *D. galeata mendotae* (Burns, 1969); a square or near square function of body length for *D. carinata* (Ganf and Shiel, 1985), *D. magna* (McMahon, 1965), *D. pulex* (Buikema, 1973; Burns, 1969; Richman, 1958), *D. middendorffiana* (Chisholm *et al.*, 1975), *D. schødleri*, *D. galeata mendotae* and *D. magna* (Burns, 1969), or is intermediate to the square and cube functions (Burns, 1969). The variable relationships reported by the same investigator working with the same species were attributed to the effects of temperature (Burns, 1969; Chisholm *et al.*, 1975) and to light intensity and state of acclimation to light (Buikema, 1973).

Generally, filtering rates increase as temperatures increase, followed by a decline as the temperature exceeds the physiologically tolerable range of the organism. This pattern was observed in *D. schødleri* (Burns, 1969; LeSuer, 1959), *D. magna* (Burns, 1969; McMahon, 1965), *D. rosea* (Burns and Rigler, 1967), *D. galeata mendotae* (Burns, 1969) and *D. middendorffiana* (Chisholm *et al.*, 1975). However, a narrow temperature-independent zone occurred in the filtering rates of *D. pulex* and *D. schødleri* (Cohn, 1957), and temperature did not significantly affect the filtering rates of *D. parvula* (Waite, 1976). The filtering rates of *D. rosea* grown at 20°C (Burns and Rigler, 1967) and 12°C (Kibby, 1971) had somewhat different patterns of response

to temperature. This suggests that temperature acclimation does affect filtering rates.

Since the relationships between filtering rate, temperature and body size in planktonic, filter-feeding crustaceans are so complex and variable, further investigation is needed. The purpose of this study was to investigate the relationships between filtering rate, temperature and body size in *Daphnia similis* Claus a common species of planktonic crustacean in Taiwan.

MATERIALS AND METHODS

The experimented *Daphnia* were obtained from the stock cultures of at the Institute of Zoology, Academia Sinica after having been maintained for more than three months. The stock cultures were initiated with the animals collected from the fish pond in Chu-Pei, and maintained in separate growth chambers with the temperature controlled at 15°C, 20°C, 25°C and 30°C and a photoperiod of 16L/8D at 600 lux intensity. Dechlorinated and filtered (Whatman GF/C fiber-glass filter disc) tap-water was used as a culture medium to which cells of *Chlorella* sp. were added in excess of 90,000 cells/ml.

The alga (*Chlorella* sp.) used as food for the *Daphnia* culture and in the feeding experiments was cultured with Bold's medium (Nichols and Bold, 1965) at 25°C and a photoperiod of 12L/12D and 2,000 lux intensity. The algal culture at the log growth phase was concentrated by centrifugation at 2,900×g for 2 minutes, and was used to feed the *Daphnia* and to prepare algal suspensions of different concentrations for feeding experiments.

Unacclimated animals (*i.e.* animals used for testing acute response to temperature changes) were obtained from the cultures maintained at 25°C for more than two life cycles. Acclimated animals

were obtained from the cultures maintained at their respective test temperatures (15°C, 20°C, 25°C and 30°C) for more than two life cycles.

One day prior to the experiments, *Daphnia* of various sizes were isolated from the stock cultures, and transferred into separate glass vials (15 ml capacity) containing filtered (0.45 μ m Millipore membrane filter) and aerated (24 h) tap-water which had been dechlorinated first (hereafter this water will be referred to as filtered water). Ten to fifteen animals were placed in each vial, and starved for 24 h to empty their gut of excessive food. During the process of starvation, the vials with animals were kept in separate growth chambers which were regulated at the test temperatures (15°C, 20°C, 25°C and 30°C). After 24 h of precondition at the test temperature, 10–15 animals (depending on their size) of similar size were first gently picked up from the vials with a wide pore glass dropper, rinsed several times with filtered water, and then carefully placed into a 60-ml BOD bottle containing the test concentration of algal suspension. Concurrently, several control bottles containing the same concentration of algal suspension only were also prepared in the same manner. The experimental and control bottles were then fastened to a wheel in a temperature controlled water bath with the light turned off and rotated end-over-end at a speed of 1 rpm to keep the algal cells in homogenous suspension. The experiments were carried out in the dark to minimize the change in the algal cell concentration owing to multiplication.

The size of the *Daphnia* were expressed in length of carapace (mm) and dry body weight (μ g). The carapace length of *Daphnia* was measured to the nearest 0.01 mm from the anterior margin of the carapace to the base of the caudal spine. The dry body weight of the *Da-*

phnia was then estimated from the carapace length by an equation describing the weight-length relationship (C.H. Lei, unpublished data):

$$W = 7.99 L^{3.45}$$

where W is the dry weight in μ g and L is the carapace length in mm.

After 2 hours of incubation, the bottles were removed from the wheel, and the concentration of algal cell in both the control and experimental bottles were determined using a partial analyzer (Elzone 180XY) with a 95 μ m diameter aperture tube. Because pond water must be made saline to conduct electric current, the content of each bottle was diluted with an equal amount of 1% NaCl solution which had been filtered 3 times through a membrane filter with a 0.20 μ m pore size to get a salinity of 0.5‰ before counting (Mulligan and Kingsbury, 1968). From the differences in algal cell concentration between the mean of controls and each experimental bottle, the filtering rate (F , ml/animal/hr) was computed with the following formula (Gauld, 1951)

$$F = \frac{V(\ln C_o - \ln C_i)}{NT}$$

where V is the volume of algal suspension in the experimental bottle, N the number of animals in the experimental bottle, T the duration (hour) of incubation, and C_o and C_i the algal cell concentration in the control bottle and experimental bottle, respectively after a 2 h incubation.

The filtering rate measurements were made during the same time of a day (between 1100 and 1300 hours) to avoid a possible diurnal rhythm effect. The algal cell concentration used in the experiments was 2×10^5 cells/ml.

Regression coefficients (b values) and a variance analysis were determined for the filtering rate as a function of dry

body weight for each temperature condition and state of acclimation. Before calculation the values of dry body weight and filtering rates were logarithmically transformed. The b values and adjusted means between and among unacclimated and acclimated conditions were compared statistically to each other for differences through a covariance analysis (Snedecor and Cochran, 1980). If there was a significant difference among adjusted means, then the adjusted means which were significantly different from each other were determined following the procedures described in Snedecor and Cochran (1980).

RESULTS

Filtering rates of acclimated animals

1. Relationship between filtering rate and body size

The filtering rate of acclimated *D.*

similis increased with increasing dry body weight at each temperature (Tables 1 and 2). The b values of the regression equations relating filtering rate to dry body weight varied from 0.406 to 0.593 but this difference among the b values determined at different temperatures was insignificant ($F=0.60$; $df=3, 42$; $p>0.05$). The weight-specific filtering rate of acclimated *D. similis*, except for the rate at 25°C, was significantly and negatively correlated with the dry body weight (Table 3).

2. Relationship between filtering rate and temperature

To test if there was a significant difference in filtering rates among animals studied at different temperatures, the mean filtering rate was first adjusted by covariance analysis to remove the effect caused by difference in size (Table 1). The variance ratio ($F=1.86$) was non-significant ($df=3, 45$; $p>0.05$), indicating

Table 1
Filtering rate (F in ml/animal per hr) of various sized (mean dry weight, W in μg) *Daphnia similis* at cultured temperatures

15°C		20°C		25°C		30°C	
W	F	W	F	W	F	W	F
1.81	0.0205	1.19	0.0473	1.61	0.0228	0.90	0.0072
2.01	0.0282	1.30	0.0158	2.06	0.0532	1.54	0.0369
2.34	0.0349	1.63	0.0189	2.15	0.0081	2.74	0.0866
3.15	0.0444	1.76	0.0641	2.80	0.0258	3.95	0.0594
7.07	0.0325	4.56	0.0411	4.81	0.0826	4.47	0.0732
12.18	0.0557	4.66	0.0602	10.83	0.0441	4.53	0.0782
13.26	0.0895	5.21	0.0306	12.30	0.1183	6.58	0.1015
26.59	0.1499	5.41	0.0280	22.27	0.1662	7.20	0.0678
38.96	0.1786	7.48	0.0410	23.61	0.1726	12.30	0.2354
54.62	0.1487	14.27	0.0543	33.33	0.0359	21.54	0.1740
58.49	0.1546	30.54	0.1029	44.95	0.2114	32.36	0.2016
		35.27	0.0990			33.33	0.1071
		41.92	0.1300			36.23	0.0889
		51.15	0.1172				
		55.93	0.1359				
Adjusted ¹ mean							
	0.0589		0.0544		0.0581		0.0838

1. Adjusted mean: mean adjusted for size by covariance analysis to a common size of 8.23 μg dry body weight. The values are calculated using logarithmically transformed data and then back-transformed to the original scale.

Table 2
Regression equations relating filtering rate (F , ml/animal/hr)
to dry body weight (W , μg) for *Daphnia similis* under
cultured temperatures

Temperature (°C)	Regression equation	Correlation coefficient (r)
15	$\log F = -1.747 + 0.561 \log W$	0.945***
20	$\log F = -1.638 + 0.406 \log W$	0.821***
25	$\log F = -1.778 + 0.593 \log W$	0.715*
30	$\log F = -1.595 + 0.570 \log W$	0.774**

* denotes significance at $p < 0.05$.

** denotes significance at $p < 0.01$.

*** denotes significance at $p < 0.001$.

Table 3
Regression equations relating weight specific filtering rate (F , ml/ μg wt/hr)
to dry body weight (W , μg) for *Daphnia similis*
under cultured temperatures

Temperature (°C)	Regression equation	Correlation coefficient (r)
15	$\log F = -1.747 - 0.439 \log W$	-0.916***
20	$\log F = -1.638 - 0.594 \log W$	-0.903***
25	$\log F = -1.778 - 0.407 \log W$	-0.575 ns
30	$\log F = -1.596 - 0.429 \log W$	-0.679*

ns denotes non-significance, $p < 0.05$.

* denotes significance at $p < 0.05$.

*** denotes significance at $p < 0.001$.

that *D. similis* had similar filtering rates after acclimating to different temperatures.

Filtering rates of unacclimated animals

1. Relationship between filtering rate and body size

The filtering rate of unacclimated *D. similis* increased with increasing dry body weight (Tables 4 and 5) at each temperature. The b values for the regression equations relating filtering rate to dry body weight varied from 0.452 to 0.511. However, the difference among the b values was insignificant ($F=0.39$; $df=3, 49$; $p>0.05$). The weight-specific filtering rate of unacclimated *D. similis* was signifi-

cantly and negatively correlated with the dry body weight (Table 6).

2. Relationship between filtering rate and temperature

To test if there was a significant difference in the filtering rates among animals studied at different temperatures, the mean filtering rate was first adjusted by covariance analysis to remove the effect caused by difference in size (Table 4). The variance ratio ($F=3.39$) was significant ($p < 0.05$; $df=3, 52$), indicating that unacclimated *D. similis* had different filtering rates under different temperatures. Although, the adjusted mean of the filtering rate for animals at 20°C was

Table 4
Filtering rate (F in ml/animal per hr) of various sized (mean dry weight, W in μg) *Daphnia similis* cultured at 25°C and measured at various temperatures

15°C		20°C		25°C		30°C	
W	F	W	F	W	F	W	F
0.90	0.0256	1.63	0.0232	1.61	0.0228	0.91	0.0304
1.02	0.0274	2.22	0.0686	2.06	0.0532	1.17	0.0158
1.02	0.0337	4.20	0.1006	2.15	0.0081	3.62	0.0464
1.58	0.0436	5.35	0.0755	2.80	0.0258	4.03	0.0265
4.03	0.0310	9.18	0.1154	4.81	0.0826	6.34	0.0664
6.34	0.0752	9.21	0.0732	10.83	0.0441	7.72	0.0433
6.51	0.0395	13.94	0.1734	12.30	0.1183	9.40	0.0693
7.02	0.0518	17.02	0.1728	22.27	0.1662	18.88	0.0488
7.99	0.0334	22.50	0.2114	23.61	0.1726	27.11	0.1107
18.58	0.0673	25.51	0.1518	33.33	0.0359	32.36	0.1029
20.18	0.1306	34.25	0.2005	44.95	0.2114	37.62	0.1132
21.93	0.1757	38.29	0.1201			41.12	0.1588
26.78	0.1295	40.42	0.1306			42.10	0.1567
27.11	0.1330	60.67	0.3130			50.63	0.2002
29.34	0.1963	61.61	0.1742				
36.88	0.0891						
40.42	0.1400						
Adjusted ¹							
mean	0.0743 ^a		0.1025 ^b		0.0645 ^a		0.0644 ^a

1. Adjusted mean: mean adjusted for size by covariance analysis to a common size of 10.17 μg dry body weight. The values are calculated using logarithmically transformed data and then back-transformed to the original scale. Means designated by different letters are significantly different at $p < 0.05$.

Table 5
Regression equations relating filtering rate (F , ml/animal/hr) to dry body weight (W , μg) for *Daphnia similis* cultured at 25°C and measured at various temperatures

Temperature (°C)	Regression equation	Correlation coefficient (r)
15	$\log F = -1.589 + 0.452 \log W$	0.862***
20	$\log F = -1.439 + 0.452 \log W$	0.834***
30	$\log F = -1.706 + 0.511 \log W$	0.913***

*** denotes significance at $p < 0.001$.

significantly higher than those at three other temperatures, the differences among the adjusted means of the three other temperature regimes themselves, *i. e.*, 15°C, 25°C and 30°C, were not significant (Table 4).

Comparisons of filtering rates in acclimated and unacclimated animals

Acclimation to the respective temperature conditions did not result in significantly different b values for the filtering rate-body weight relationship

Table 6

Regression equations relating weight specific filtering rate (F , ml/ μ g wt/hr) to dry body weight (W , μ g) for *Daphnia similis* cultured at 25°C and measured at various temperatures

Temperature (°C)	Regression equation	Correlation coefficient (r)
15	$\log F = -1.588 - 0.548 \log W$	-0.900***
20	$\log F = -1.438 - 0.549 \log W$	-0.877***
30	$\log F = -1.705 - 0.489 \log W$	-0.906***

*** denotes significance at $p < 0.001$.

Table 7

Relationship of filtering rate to dry body weight for *Daphnia similis* under various temperatures. F value significant at $p < 0.05$ and $p < 0.001$ is designated with one asterisk (*) and three asterisks (***), respectively; N =sample size

Test temperature (°C)	b values (S_b) ¹				F values	
	N	Unacclimated ²	N	Acclimated ³	Between b values	Between adjusted means
15	17	0.452(0.069)	11	0.561(0.064)	1.16	0.901
20	15	0.452(0.083)	15	0.406(0.078)	0.157	16.21***
30	14	0.511(0.066)	13	0.570(0.141)	0.161	4.60*

1. All values of b are significantly different from zero, $p < 0.05$. The number in the parenthesis is the standard error of regression coefficient, b .
2. Animals maintained at 25°C.
3. Animals exposed to respective test temperatures.

(Table 7). However, the adjusted mean of filtering rates for the animals acclimated to 20°C and 30°C were significantly different from those for unacclimated animals tested at the same temperatures. The adjusted mean of the filtering rate for animals acclimated at 20°C was lower, whereas the adjusted mean of the filtering rate for animals acclimated at 30°C was higher than that for unacclimated animals tested at the same temperatures. This result suggests that acclimation to temperature may be an important variable in the feeding studies of *Daphnia*. However, the effect of acclimation depends on the magnitude of the temperature studied, and their direction of response is unpredictable.

DISCUSSION

The filtering rate of *D. similis* increased with increasing body size (Table 1) as in other species of *Daphnia* (Armitage and Lei, 1979; Buikema, 1973; Burns, 1969; Burns and Rigler, 1967; Chisholm *et al.*, 1975; DeMott, 1982; Downing and Peters, 1980; Ganf and Shiel, 1985; Holm *et al.*, 1983; Kring and O'Brien, 1976; Kryutchkova and Sladeczek, 1969; LeSuer, 1959; Richman, 1958; Ryther, 1954). The relationship between the filtering rate and body length can be appropriately expressed by the equation (Buikema, 1973; Burns, 1969; Burns and Rigler, 1967; Chisholm *et al.*, 1975; DeMott, 1982; Ganf and Shiel, 1985; Holm *et al.*, 1983; Kring

and O'Brien, 1976; McMahon, 1965; Reeve, 1963; Richman, 1958)

$$\log F = \log a + b \log L \text{ (or } F = aL^b \text{)}$$

where F is the filtering rate per animal per time unit, L is the body length, b is the regression coefficient (or slope), and $\log a$ is the Y intercept. Brooks and Dodson (1965) and Sushchenya (1959) have emphasized that the filtering rate should be proportional to the square of the body length in filter-feeding Cladocera. In terms of the simplest hypothesis based on the geometry of the filtering process, filtering area (A) of *Daphnia* can be predicted to be proportional to the square of a linear dimension (L , body length), i.e., $A \propto L^2$, and the filtering rate (R) can be proportional to the cube of a linear dimension, i.e., $R \propto L^3$, given the hypothesis that the rate is dependent on the volume through which the filtering seta is swept (Egloff and Palmer, 1971). However, the increase in the filtration rate relative to the body length varies among species. As stated, the filtering rate of *Daphnia* could be a cube or near cube function of body length, a square or near square function of body length, or intermediate to the square and cube functions. Egloff and Palmer (1971) stated that b values less than 3 are not unexpected given a variety of behavioral and environmental factors that can inhibit *Daphnia* feeding, e.g., cessation or variation of thoracic limb movement or the rejection of filtered food particles before ingestion (Burns, 1968).

The b value for the pooled data (1.701 for unacclimated animals; 1.784 for acclimated animals) for *D. similis* in this study is similar to those reported for *D. ambigua* (1.694, Armitage and Lei, 1979) and *D. pulex* (1.70 to 1.832, Buikema, 1973; 1.922, Richman, 1958) where the filtering rate was a near square function of body length. Because there was no significant

difference among b values determined at different temperatures for both unacclimated and acclimated animals in this study, we cannot demonstrate any effects of temperature on the relationship of filtering rate and body size (both in terms of dry body weight and carapace length).

Weight-specific filtering rates of *D. similis*, except for those determined at 25°C, decreased with increasing body size as reported for *D. magna* (Ryther, 1954), *D. pulex* (Richman, 1958), *D. pulex obtusa* (Kryutachkova and Sladeczek, 1969) and *D. schødleri* (LeSuer, 1959). However, in some other studies, weight-specific filtering rates were found to be independent of body size, for example, in *D. ambigua* (Armitage and Lei, 1979), *D. galeata mendotae* (Burns, 1969), *D. magna* (Burns, 1969; Schindler, 1968), *D. pulex* (Burns, 1969; Kring, 1975) and *D. schødleri* (Burns, 1969). The lack of statistical significance for the correlation between weight-specific filtering rate and body size (dry weight) at 25°C in this study could result from the great variability of the data. If two extreme low values of filtering rate (for dry body weight of 2.15 and 33.33 µg) are excluded, the correlation then becomes significant at $p < 0.05$.

The relationship between the filtering rate (F) and dry body weight (W) of *D. similis* can also be appropriately expressed by a power curve function as

$$F = a W^b$$

or by a logarithmically transformed equation as

$$\log F = \log a + b \log W$$

The b values of the equation ranged from 0.406 to 0.593 and 0.452 to 0.511 for acclimated and unacclimated animals, respectively. Since there was no significant difference among b values determined at different temperatures for both acclimated and unacclimated animals in this

study, we cannot demonstrate any temperature effects on the relationship of the filtering rate and the dry body weight. The common *b* value for pooled data is 0.515 and 0.493 for acclimated and unacclimated animals, respectively.

The relationship between temperature and the filtering rate of planktonic crustaceans is complex. Filtering rates generally increase with temperature up to some optimal value for the species and then decline (Parsons *et al.*, 1984). The temperature of the maximum filtering rates differs among species of *Daphnia*, e. g., 20°C for *D. pulex* and *D. schødler* (Burns, 1969), 25°C or higher for *D. galeata mendotae* and *D. magna* (Burns, 1969; McMahon, 1965), and around 12°C for *D. middendorffiana* (Chisholm *et al.*, 1975). Temperature acclimation may affect the response of the filtering rate to temperature, and alter the temperature of the maximum filtering rate. Filtering rates for *D. rosea* grown at 20°C increased with increasing temperatures from 5 to 20°C then declined at 25°C (Burns and Rigler, 1967), but the rate for *D. rosea* grown at 12°C and measured at the same range of temperatures increased with increasing temperatures from 5°C to 14°C then declined with further increases in temperature (Kibby, 1971).

The filtering rate of *D. similis* at the range of temperatures tested in this study did not exhibit any systematic change in relation to temperature, and did not follow the general pattern of temperature response demonstrated in other species of zooplankton. The filtering rates of *D. similis* grown at 25°C and measured at various temperatures was not the highest at 25°C (Table 4) as would be expected from the general pattern of temperature responses demonstrated in other species of zooplankton (Burns, 1969; Burns and Rigler, 1967; Kibby, 1971; McMahon, 1965). The reason for this discrepancy is not known. Since there is no significant differ-

ence among the adjusted means of the filtering rate for acclimated animals determined at respective culture temperatures, it appears that *D. similis* after a long period of acclimation to different temperatures will have similar filtering rates. This suggests that temperature acclimation may be an important variable in feeding studies of *Daphnia* and thus needs further study.

For similar sized animals at similar temperatures, the filtering rates of *D. similis* in this study were lower than those reported for *D. ambigua* (Armitage and Lei, 1979), *D. galeata mendotae* (Burns, 1969), *D. magna* (Burns, 1969; McMahon, 1965), *D. parvula* (Waite, 1976), *D. pulex* (Buikema, 1973; Burns, 1969; Richman, 1958), *D. pulex obtusa* (Kryutchkova and Sladeck, 1969), *D. rosea* (Burns and Rigler, 1967; Kibby, 1971) and *D. schødleri* (Burns, 1969; LeSuer, 1959). The low filtering rates obtained for *D. similis* in this study probably resulted mainly from high concentration of algal suspension (2×10^5 cells/ml) used in the feeding experiments. Since crowding of organisms has been shown to result in a decreased filtering rate in copepods (Berner, 1962; Cushing, 1958; Folt, 1986; Hargrave and Geen, 1970; Marshall and Orr, 1955, 1962) and cladocerans (Buikema, 1973; Hayward and Gallup, 1976; Helgen, 1987; Peters and Downing, 1984), crowding of animals (1 animal/4 ml and 1 animal/6 ml) may also partially account for the lower filtering rate obtained for *D. similis* in this study.

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水蚤 (*Daphnia similis* Claus) 之濾水率 與溫度及個體大小之關係

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本研究利用未經馴化及經馴化之不同大小雌水蚤 (*Daphnia similis* Claus) 在綠藻濃度 2×10^5 cells/ml 及溫度分別為 15, 20, 25 與 30°C 之狀況下測定其濾水率，以探討濾水率與個體大小及溫度間之關係。在所有測試溫度下，濾水率 (F , ml/animal/hr) 皆隨乾體重 (W , μg) 而異速增加。濾水率與乾體重之 0.406~0.593 乘冪成正比。濾水率—乾體重關係式 $\log F = \log a + b \log W$ 之指數 b 值並不受溫度及溫度馴化狀況之影響。單位體重濾水率隨乾體重之增大而減小。馴化動物之濾水率並不受溫度影響，但未馴化動物之濾水率則受溫度之一些影響。

